

ADVANCED MANUFACTURING I

Advanced Manufacturing I is a course that includes classroom and laboratory experiences in two broad areas: Industrial Technology/Software Controls and Manufacturing Trends. Industrial Technology and Software Controls covers wiring and schematic diagrams used to design, install, and repair electrical/electronic equipment such as wireless communication devices, programmable controllers. Course content will include basic theories of electricity, electronics, digital technology, and basic circuit analysis. Activities include experiences in: soldering; use of an oscilloscope, meters, signal generators and tracers; breadboarding; circuit simulation software; and troubleshooting. Understanding and using the underlying scientific principles related to electricity, electronics, circuits, sine waves, and Ohm's Law are integral to this course. Manufacturing Trends covers basic concepts in manufacturing operations and plant floor layout in the production environment. Applications of Computer Numerical Control (CNC), and lathe and turning operations are developed as a foundation for machining operations. Coordinate system concepts are introduced as relevant to machining processes, as well as fluid and mechanical power, welding, and lean manufacturing. Fluid power concepts will include hydraulic components and circuits, laws and principles, fluid power controllers, and the construction of systems. In the mechanical power portion of the course, students will learn about machine specifications, basic forces, friction, simple machines, motors, and motor controls. Students will also be introduced to lean manufacturing where they will study concepts including: lean goals, product quality, eliminating waste, cost effectiveness, lean concepts, resource planning, continuous improvement, and the various advantages of lean manufacturing. This course includes MSSC concepts required to earn MSSC certification.

- DOE Code: 5608
- Recommended Grade Level: Grade 11-12
- Recommended Prerequisites: Introduction to Advanced Manufacturing
- Credits: 2-3 credits per semester, maximum of 6 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with the following Post-Secondary courses for Dual Credit:
 - Ivy Tech
 - ADMF 101- Key Principles of ADMF
 - ADMF 102- Technology in ADMF
 - ADMF 113- Electrical and Electronic Principles of Manufacturing
 - Vincennes University
 - CIMT 100/L -Electronics for Automation

Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences. When a course is offered for multiple hours per semester, the amount of laboratory application or work-based learning needs to be increased proportionally.

Career and Technical Student Organizations (CTSOs)

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in SkillsUSA, the CTSO for this area.

Content Standards

Domain - Electronic Principles

Core Standard 1 Students analyze the laws, principles, and types of electricity to utilize, repair, and maintain equipment used in an industrial environment.

Standards

- AMI-1.1 Apply principles of lab and electrical wiring safety in commercial and residential settings
- AMI-1.2 Apply Ohm's Law and the power law
- AMI-1.3 Identify series and parallel circuits
- AMI-1.4 Solve series and parallel circuits using basic laws of electricity
- AMI-1.5 Discuss power supply and voltage regulation as applied to basic electricity
- AMI-1.6 Study the traits and characteristics of AC (alternating current) and DC (direct current)
- AMI-1.7 Introduce single and three phase AC power
- AMI-1.8 Understand relay operation and applications
- AMI-1.9 Discuss the digital logic circuits (basic gate theory)

Domain - Electronic Devices

Core Standard 2 Students evaluate devices and components in the electrical field to improve manufacturing processes.

Standards

- AMI-2.1 Demonstrate the understanding of the theory and function of switches, loads, resistors, capacitors, coils, and other basic electronic components
- AMI-2.2 Troubleshoot solid state switching devices using basic circuits

Domain – Circuit Construction

Core Standard 3 Students demonstrate proper-construction, measurement, and testing techniques to create and circuits.

Standards

- AMI-3.1 Demonstrate the principles of testing and test equipment operation
- AMI-3.2 Test basic electronic parts found in industrial electronics
- AMI-3.3 Build, and test and electrical/electronic project
- AMI-3.4 Solve electrical problems
- AMI-3.5 Build simple electronic circuits using switches, light bulbs, resistors, capacitors, coils, and other basic electronic equipment
- AMI-3.6 Measure electrical characteristics of voltage, current, and resistance in basic electronic circuits using multi-meters and oscilloscopes
- AMI-3.7 Build electronic circuits with basic TTL logic with And, Or, Nand, Nor, Buffer, and Inverter chips

- AMI-3.8 Assemble through-hole and surface mount parts
- AMI-3.9 Create industry acceptable solder joints and demonstrate successful desoldering techniques

Domain – PLC Fundamentals

Core Standard 4 Students analyze the fundamentals of Programmable Logic Circuits (PLC's) to assess their role in manufacturing processes.

Standards

- AMI-4.1 Distinguish PLC components and their function
- AMI-4.2 Select most appropriate type of circuit logic for each application
- AMI-4.3 Understand varying types of hardware used throughout industry
- AMI-4.4 Apply suitable commands for PLC circuits
- AMI-4.5 Interpret programming diagrams
- AMI-4.6 Create programming diagrams for real-world applications
- AMI-4.7 Apply timer and counter principles to industry-related problems
- AMI-4.8 Setup and test PLC's
- AMI-4.9 Troubleshoot issues with PLC's
- AMI-4.10 Perform basic maintenance with PLC's

Domain – Electrical Impacts

Core Standard 5 Students evaluate the impact of electricity and electrical concepts on society to explore new manufacturing technologies.

Standards

- AMLI-5.1 Describe how electricity and electrical components have an impact on today's society and the environment
- AMLI-5.2 Effectively use current and emerging computer technologies utilized in industry
- AMLI-5.3 Discuss other new and emerging technologies within or related to the field of manufacturing

Domain – Manufacturing Essentials

Core Standard 6 Students analyze essential aspects of manufacturing today to appraise manufacturing processes.

Standards

- AMI-6.1 Describe manufacturing plant organization and functional layout based upon process flow
- AMI-6.2 Explain the history of computer numerical control in machining
- AMI-6.3 Illustrate the Cartesian coordinate system in defining points, shape, form, and function in a machining environment
- AMI-6.4 Describe major component and types of lathes and turning processes common in CNC operations
- AMI-6.5 Describe major component and types of machining centers and processes common in CNC operations

Domain – Fluid Power Principles

Core Standard 7 Students analyze fluid power fundamentals to explore it's role in manufacturing equipment operation and performance.

Standards

- AMI-7.1 Explain flow rate and the abbreviations GPM and CFM
- AMI-7.2 Assess common hydraulic components, their use, symbols, and mathematical models
- AMI-7.3 Formulate and analyze simple mathematical models of hydraulic circuits
- AMI-7.4 Compare advantages and disadvantages of various types of controllers
- AMI-7.5 Become familiar with the effects fluid power has on the outside world
- AMI-7.6 Construction of simple fluid power system circuits and taking measurements on them
- AMI-7.7 Define fluid power, hydraulic, and pneumatic

Domain – Mechanical Principles

Core Standard 8 Students evaluate principles of forces and mechanical advantage to break down equipment operations.

Standards

- AMI-8.1 Describe the importance of machine specifications and how they are used
- AMI-8.2 Define mechanical terms such as horsepower, torque, friction, thrust, and efficiency
- AMI-8.3 Explain the relationships between rpm, horsepower, and torque
- AMI-8.4 Identify the types of friction in various situations
- AMI-8.5 Describe force and the units of PSI
- AMI-8.6 Understand machine specifications
- AMI-8.7 Apply simple machines to achieve mechanical advantage
- AMI-8.8 Recognize a variety of industrial motors and motor controls by application
- AMI-8.9 Perform mechanical power transmission safety procedures
- AMI-8.10 Examine the relationship between bearings, couplings, and gear drives
- AMI-8.11 Explain belt drive concepts, v-belt operation, belt tensioning, and belt tension measurement
- AMI-8.12 Explain chain drive operation
- AMI-8.13 Demonstrate chain tensioning and tension measurement procedures
- AMI-8.14 Perform fixed center chain installation procedures

Domain – Welding Fundamentals

Core Standard 9 Students apply and adapt basic welding principles to manufacturing processes as appropriate.

Standards

- AMI-9.1 Determine when to utilize the various types of welding
- AMI-9.2 Apply the typical welding joints for different applications
- AMI-9.3 Construct welding symbols for product drawings
- AMI-9.4 Select the appropriate welding technique for various scenarios
- AMI-9.5 Distinguish the discontinuities of faulty welds with their root causes
- AMI-9.6 Select appropriate cutting techniques
- AMI-9.7 Utilize material layout strategies for efficiency in fabrication
- AMI-9.8 Demonstrate a basic understanding of automated processes related to welding and cutting

Domain – Fundamentals of Lean Manufacturing

Core Standard 10 Students analyze the impact of lean principles and concepts on manufacturing to improve processes.

Standards

- AMI-10.1 Describe Lean manufacturing and explain its importance
- AMI-10.2 Understand the four goals of lean manufacturing
- AMI-10.3 Identify the seven types of waste in industrial situations
- AMI-10.4 Describe seven methods manufacturers use to keep production costs low
- AMI-10.5 Describe Just-in-time inventory control and give a benefit
- AMI-10.6 Demonstrate an understanding of the basic terms, disciplines, and concepts of Lean
- AMI-10.7 Describe MRP and MRP II and explain their importance
- AMI-10.8 Describe ERP and explain its importance
- AMI-10.9 Define the importance and need for making a commitment to achieve the implementation of Lean disciplines
- AMI-10.10 Implement the concepts of lean manufacturing to enhance operations
- AMI-10.11 Define methodologies required to achieve continuous improvement
- AMI-10.12 Explain the major advantages of Lean over conventional operating methods
- AMI-10.13 Define the differences between value-added and non-value activities
- AMI-10.14 Identify the sources and types of waste-streams in manufacturing or service/supply industry

Process Standards

Common Core Literacy Standards for Technical Subjects

Reading Standards for Literacy in Technical Subjects 11-12

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

- 11-12.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- 11-12.RT.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- 11-12.RT.3 Follow precisely a complex multistep procedure when performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

- 11-12.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and

phrases as they are used in a specific scientific context relevant to *grades 11-12 texts and topics*.

- 11-12.RT.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- 11-12.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Idea

- 11-12.RT.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- 11-12.RT.8 Evaluate the hypotheses, data, analysis, and conclusions in a technical subject, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- 11-12.RT.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

- 11-12.RT.10 By the end of grade 12, read and comprehend technical texts in the grades 11-CCR text complexity band independently and proficiently.

Writing Standards for Literacy in Technical Subjects 11-12

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Text Types and Purposes

- 11-12.WT.1 Write arguments focused on *discipline-specific content*.
- 11-12.WT.2 Write informative/explanatory texts, including technical processes.
- 11-12.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

- 11-12.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 11-12.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- 11-12.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

- 11-12.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- 11-12.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectivity to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation
- 11-12.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

- 11-12.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.